

REMARKS

This is intended as a full and complete response to the Office Action dated June 13, 2006, having a shortened statutory period for response set to expire on September 13, 2006. Please reconsider the claims pending in the application for the reasons discussed below.

Claims 1-5, 9-14, 17-20, 24-30, 34-38, 40, 42, 43, and 45 remain pending in the application and are shown above. Claims 1-5, 9-14, 17-20, 24-30, 34-38, 40, 42, 43, and 45 are rejected. Reconsideration of the rejected claims is requested for the reasons presented below.

Claims 1-5, 9-14, 17-20, 24-30, 34-38, 40, 42, 43, and 45 are rejected under 35 U.S.C. 112, second paragraph. Applicant has replaced the phrase “comprising about 70% or less by weight of sulfuric acid and hydrofluoric acid” in independent claims 1, 14, and 29 with “comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight” to clarify that the 70% or less refers to the sulfuric acid only. Applicant has also amended the claims to clarify that the aqueous solution comprises an amount of sulfuric acid, and thus has a concentration of sulfuric acid that is not 0%. Applicant has also amended claims 25 and 37 to more clearly recite the claimed subject matter. Applicant submits that the changes made herein do not introduce new matter. Applicant respectfully requests withdrawal of the rejection of claims 1-5, 9-14, 17-20, 24-30, 34-38, 40, 42, 43, and 45.

Claims 1-2, 5, 9-12, 14, 20, and 24-27 are rejected under 35 U.S.C. § 102(b) as being anticipated by *Ramachandran, et al.* (WO-02/10480). The Examiner states that *Ramachandran et al.* discloses a method of removing residue from a substrate using an etchant composition comprising about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric acid and rinsing the substrate. The Examiner asserts that the recitation of “about 70% or less by weight” with respect to the sulfuric acid concentration of the aqueous solution in the claims reads on 0% sulfuric acid and concludes that the claimed process is anticipated. Applicant respectfully traverses the rejection.

Ramachandran, et al. describes a method of forming a cleaning solution that includes mixing 98 percent by weight of sulfuric acid with other components. Applicant respectfully submits that *Ramachandran, et al.* does not teach, suggest, or motivate using a concentration of sulfuric acid other than 98% to form a solution that is then diluted to form the cleaning solution described therein. Applicant further submits that *Ramachandran, et al.* does not teach or suggest that the concentration of sulfuric acid in an intermediate solution that is diluted to form a cleaning solution is a result effective variable to be optimized.

In response to the Examiner's statement that the use of intermediate solutions having different concentrations of sulfuric acid does not provide different results since the cleaning solution which is used is disclosed in the references, and the dilution of an intermediate solution to form the cleaning solution would not affect the process of cleaning, Applicant respectfully submits that the Examiner's statement is irrelevant, as the pending claims do not require a cleaning result that is different from cleaning results obtained by using a similar cleaning solution that is prepared by a different method. Applicant notes that the instant specification describes an undesirable highly exothermic effect when a high concentration, e.g., 98%, of sulfuric acid is used to form a solution. The instant specification also discloses that the use of a sulfuric acid concentration of 70% or less results in only a small temperature increase of the resulting solution (paragraph [0018] on pages 6-7). Applicant submits that neither *Ramachandran, et al.* nor the other references used by the Examiner, i.e., *Rath, et al.* (U.S. Patent No. 6,630,074 or EP-0918081), *Ramachandran, et al.*, *Kuhn-Kuhnenfeld, et al.*, *Gotoh, et al.*, and *Oonishi, et al.*, describes an undesirable exothermic effect from using a high concentration of sulfuric acid and thus does not provide a motivation for using a lower concentration of sulfuric acid.

Therefore, *Ramachandran, et al.* does not teach, show, or suggest a method for removing a residue from a substrate surface, comprising mixing an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight, with a hydrogen peroxide solution to produce an intermediate solution at a predetermined temperature of about 3°C or less higher than temperatures of the aqueous solution and the hydrogen

peroxide solution, diluting the intermediate solution with water to form a cleaning solution, wherein the cleaning solution comprises hydrogen peroxide at a concentration within a range from about 1% to about 15% by weight, sulfuric acid at a concentration within a range from about 1% to about 10% by weight, and hydrogen fluoride at a concentration within a range from about 10 ppm to about 1,000 ppm, applying an aliquot of the cleaning solution to a substrate surface for a time period, and rinsing the aliquot from the substrate surface with water to form a wash solution, as recited in claim 1. Applicant respectfully requests withdrawal of the rejection of claim 1 and of claims 2, 5, and 9-12, which depend thereon.

Similarly, *Ramachandran, et al.* does not teach, show, or suggest a method for cleaning a residue from a substrate surface, comprising combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight, with a hydrogen peroxide solution at a predetermined weight ratio of about 1 to about 20 to form an intermediate solution at a predetermined temperature of about 3°C or less higher than temperatures of the aqueous solution and the hydrogen peroxide solution, diluting the intermediate solution with water to form a cleaning solution, exposing the substrate surface to an aliquot of the cleaning solution, wherein the cleaning solution comprises hydrogen peroxide at a concentration within a range from about 1% to about 15% by weight, sulfuric acid at a concentration within a range from about 1% to about 10% by weight, and hydrogen fluoride at a concentration within a range from about 10 ppm to about 1,000 ppm, and rinsing the substrate surface with water to remove a residue and the aliquot of the cleaning solution, as recited in claim 14. Applicant respectfully requests withdrawal of the rejection of claim 14 and of claims 20 and 24-27, which depend thereon.

Claims 1-2, 5, 9-12, 14, 20, and 24-27 are rejected under 35 U.S.C. § 102(e) as being anticipated by *Rath, et al.* (U.S. Patent No. 6,630,074). The Examiner states that *Rath, et al.* (U.S. Patent No. 6,630,074) discloses a method of removing residue from a substrate using an etchant composition comprising about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric

acid and rinsing the substrate. The Examiner asserts that the recitation of “about 70% or less by weight” with respect to the sulfuric acid concentration of the aqueous solution in the claims reads on 0% sulfuric acid and concludes that the claimed process is anticipated. Applicant respectfully traverses the rejection.

Rath, et al. (U.S. Patent No. 6,630,074) describes a method of forming a cleaning solution that includes mixing 98 percent by weight of sulfuric acid with other components. Applicant respectfully submits that *Rath, et al.* (U.S. Patent No. 6,630,074) does not teach, suggest, or motivate using a concentration of sulfuric acid other than 98% to form a solution that is then diluted to form the cleaning solution described therein. Applicant further submits that *Rath, et al.* (U.S. Patent No. 6,630,074) does not teach or suggest that the concentration of sulfuric acid in an intermediate solution that is diluted to form a cleaning solution is a result effective variable to be optimized. As *Rath, et al.* (U.S. Patent No. 6,630,074) does not teach or suggest mixing or combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight, to form an intermediate solution, *Rath, et al.* (U.S. Patent No. 6,630,074) does not teach or suggest all of the limitations of claims 1-2, 5, 9-12, 14, 20, and 24-27. Applicant respectfully requests withdrawal of the rejection of claims 1-2, 5, 9-12, 14, 20, and 24-27.

Claims 1-2, 5, 9-12, 14, 20, 24-27, 38, and 43 are rejected under 35 U.S.C. § 102(b) as being anticipated by *Rath, et al.* (EP-0918081). The Examiner states that *Rath, et al.* (EP-0918081) discloses a method of removing residue from a substrate using an etchant composition comprising about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric acid and rinsing the substrate. The Examiner asserts that the recitation of “about 70% or less by weight” with respect to the sulfuric acid concentration of the aqueous solution in the claims reads on 0% sulfuric acid and concludes that the claimed process is anticipated. Applicant respectfully traverses the rejection.

Rath, et al. (EP-0918081) describes a method of forming a cleaning solution that includes mixing 98 percent by weight of sulfuric acid with other components. Applicant

respectfully submits that *Rath, et al.* (EP-0918081) does not teach, suggest, or motivate using a concentration of sulfuric acid other than 98% to form a solution that is then diluted to form the cleaning solution described therein. Applicant further submits that *Rath, et al.* (EP-0918081) does not teach or suggest that the concentration of sulfuric acid in an intermediate solution that is diluted to form a cleaning solution is a result effective variable to be optimized. As *Rath, et al.* (EP-0918081) does not teach or suggest mixing or combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight, to form an intermediate solution, *Rath, et al.* (EP-0918081) does not teach or suggest all of the limitations of claims 1-2, 5, 9-12, 14, 20, 24-27, 38, and 43. Applicant respectfully requests withdrawal of the rejection of claims 1-2, 5, 9-12, 14, 20, 24-27, 38, and 43.

Claims 1, 2, 5, 9-10, 14, 20, 24-25, and 38 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kuhn-Kuhnenfeld, et al.* (U.S. Patent No. 4,100,014). The Examiner states that *Kuhn-Kuhnenfeld, et al.* discloses a method of removing a residue from a substrate surface using an aqueous solution which includes 1 to 30% by weight of hydrofluoric acid, 2 to 30% by weight of hydrogen peroxide, 1 to 75% by weight of sulfuric acid, and 15 to 95 % by weight of water, and rinsing the substrate. The Examiner asserts that it would have been obvious to manipulate the percentage of the hydrogen fluoride concentration, the time for treatment, and temperature of *Kuhn-Kuhnenfeld, et al.* for better and efficient results. Applicant respectfully traverses the rejection.

Kuhn-Kuhnenfeld, et al. describes forming an etching solution by mixing 40% weight aqueous hydrofluoric acid, 30% weight aqueous hydrogen peroxide, and concentrated aqueous sulfuric acid of about 98% by weight. *Kuhn-Kuhnenfeld, et al.* does not teach or suggest that the etching solution is formed by diluting an intermediate solution. In particular, *Kuhn-Kuhnenfeld, et al.* does not teach or suggest using a concentration of sulfuric acid of about 70% or less by weight to form an intermediate solution that is then diluted to form the etching solution described therein. As *Kuhn-Kuhnenfeld, et al.* does not teach or suggest mixing or combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric

acid in the aqueous solution is about 70% or less by weight, to form an intermediate solution, *Kuhn-Kuhnenfeld, et al.* does not teach or suggest all of the limitations of claims 1, 2, 5, 9-10, 14, 20, 24-25, and 38. Applicant respectfully requests withdrawal of the rejection of claims 1, 2, 5, 9-10, 14, 20, 24-25, and 38.

Claims 3-4, 17-19, 29-30, 34-35, 37, 40, 42-43, and 45 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Rath, et al.* (U.S. Patent No. 6,630,074 or EP-0918081) or *Ramachandran, et al.* or *Kuhn-Kuhnenfeld, et al.* in view of *Gotoh, et al.* The Examiner acknowledges that *Rath, et al.* (U.S. Patent No. 6,630,074 or EP-0918081), *Ramachandran, et al.*, and *Kuhn-Kuhnenfeld, et al.* fail to use a surfactant in their cleaning solutions. The Examiner states that *Gotoh, et al.* discloses a method for removing residue from a substrate surface with a cleaning solution comprising hydrofluoric acid and surfactant and asserts that it would have been obvious to incorporate a surfactant in the cleaning solution of *Rath et al.*, *Ramachandran et al.*, or *Kuhn-Kuhnenfeld et al.* since the surfactants are well known to reduce the surface tension and increase wettability of the substrate. Applicant respectfully traverses the rejection.

As discussed above, *Rath, et al.* (U.S. Patent No. 6,630,074 and EP-0918081), *Ramachandran, et al.*, and *Kuhn-Kuhnenfeld, et al.* do not teach or suggest mixing or combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight to form an intermediate solution. Applicant further submits that *Gotoh, et al.*, individually or in combination with *Rath, et al.* (U.S. Patent No. 6,630,074 and EP-0918081), *Ramachandran, et al.*, and *Kuhn-Kuhnenfeld, et al.* does not teach or suggest mixing or combining an aqueous solution comprising sulfuric acid and hydrofluoric acid, wherein a concentration of the sulfuric acid in the aqueous solution is about 70% or less by weight, to form an intermediate solution. Thus, *Rath, et al.* (U.S. Patent No. 6,630,074 or EP-0918081) or *Ramachandran, et al.* or *Kuhn-Kuhnenfeld, et al.* in view of *Gotoh, et al.* does not teach or suggest all of the limitations of claims 3-4, 17-19, 29-30, 34-35, 37, 40, 42-43, and 45. Applicant respectfully requests withdrawal of the rejection of claims 3-4, 17-19, 29-30, 34-35, 37, 40, 42-43, and 45.

Claims 13, 28, and 36 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Rath, et al.* (U.S. Patent No. 6,630,074 and EP-0918081) or *Ramachandran, et al.* in view of *Oonishi, et al.* The Examiner discloses a cleaning method including a cleaning solution containing 24 wt% sulfuric acid, 5 wt% hydrogen peroxide, 0.02 wt % hydrogen fluoride, 0.075 wt% n-dodecyl-benzenesulfonic acid, and water and a megasonic technique. The Examiner asserts that it would have been obvious to incorporate the step of sonication as disclosed by *Oonishi, et al.* into the process of *Rath et al.* or *Ramachandran et al.* or *Kuhn-Kuhnenfeld et al.* to enhance the removal effect with the sonication. Applicant respectfully traverses the rejection.

Rath, et al. (U.S. Patent No. 6,630,074 and EP-0918081) and *Ramachandran, et al.* are discussed above. Applicant submits that *Oonishi, et al.* does not teach or suggest any of the elements lacking in *Rath, et al.* (U.S. Patent No. 6,630,074 and EP-0918081) and *Ramachandran, et al.* Thus, *Oonishi, et al.*, individually or in combination with *Rath, et al.* (U.S. Patent No. 6,630,074 and EP-0918081) and *Ramachandran, et al.*, does not teach or suggest all of the elements of claims 13, 28, and 36. Applicant respectfully requests withdrawal of the rejection of claims 13, 28, and 36.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully requests that the claims be allowed.

Respectfully submitted,



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